MICHIGAN DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT

INTEROFFICE COMMUNICATION

TO: File

FROM: Izabel Hartman

DATE: February 22, 2011

SUBJECT: Drinking Water Revolving Fund Project No. 7346-01
City of Grand Rapids (LMFP VFD; S. Walker Phase II)
Green Project Reserve (GPR) Funding Cost Calculation

The purpose of this memo is to document the cost calculations for the green reserve funding for the City of Grand Rapids, DWRF Project No. 7346-01. The total loan amount is $1,500,000. The portion of the project that qualifies as green is the Variable Frequency Drive installation project ($404,500). Therefore, the total cost of construction for the green portion of the project is $404,500. The total construction cost for the entire DWRF project is $1,015,893.70. In order to determine the percentage of non-construction costs associated with the green portion of the project, a proration was applied, as shown below:

404,500 / 1,015,893.70 = 0.3982

1,500,000 x 0.3982 = $597,300

The total amount of green reserve funding for this project comes to $597,300.

The principal forgiveness amount was determined using 40-percent for GPR associated costs and 15-percent for non-GPR associated costs.

The total amount of non-green funding for this project comes to $902,700 (1,500,000-597,300).

597,300 x 40% (GPR percentage) = 238,920

902,700 x 15% (Non-GPR principal forgiveness percentage) = 135,405

The total principal forgiveness amount for the project is $374,325 (238,920+135,405).

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MOORE & BRUGGINK, INC.
Consulting Engineers

May 12, 2010
Project No. G090664DRF

Ms. Izabel Hartman
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Re: ARRA Green Project Reserve
Drinking Water Revolving Fund (DWRF)
City of Grand Rapids
DWRF No. 7346-01 and 7347-01

Dear Ms. Hartman:

This letter is a follow-up to the previous Green Project Reserve (GPR) letter sent on April 29, 2010. This letter incorporates and expounds upon the previous information presented for proposed projects for the Grand Rapids Water System.

Variable Frequency Drive at LMFP

The addition of the variable frequency drive (VFD) on the low service pump at the Lake Michigan Filtration Plant (LMFP) is being submitted as a GPR project under the Energy Efficiency category. The VFD will "reduce the energy consumption" and "use energy in a more efficient way".

The South Low Lift Pump station was reviewed in detail in the *Low Lift Flow Control Improvements* Technical Memorandum (FTC&H, 2008). The report details the current operation of three large pumps in the South Low Lift Pump Station that deliver flows ranging from 25 million gallons per day (mgd) to 100 mgd during the warm weather months. At times, pumping this wide range of flows requires recirculation of water and/or throttling of a 54-inch valve in the recirculation line. Throttling the 54-inch valve wastes energy, moves the operating points of the pumps to a less efficient point, and causes the valve to vibrate and cavitate. The vibration and cavitation results in excessive wear, which leads to concern about the possibility of the valve failing. In 2009, excessive wear on the 54-inch valve required replacement of the valve after just 17 years of operation at a cost of $175,000, including construction and engineering.

Six alternatives were reviewed for regulating the South Low Lift flows without using the 54-inch valve. These alternatives include direct throttling of pumps at the pump discharge without recirculation, installation of one or more VFDs, magnetically coupled drives, installation of a smaller pump with reduced throttling and recirculation, operation of both the North and South Low Lift Pump Stations during warm weather, and installation of an alternative bypass and throttling valve. Of the six alternatives, the most operationally and energy friendly alternative was determined to be installation of one or more VFDs.

The energy and cost savings for installing VFDs on one large pump, one small pump, two small pumps, and one large and one small pump were evaluated. Installation of a VFD on one large pump was found to have the quickest return on investment, and an energy savings of 21.7%.

The VFD project at the LMFP was designed for energy savings and improved treatment plant operation. The energy savings was calculated by reviewing pump operation for two years. In this time period, the South Low Lift Pump Station operated for 340 days (170 days per year) during the warm weather periods. The total energy for pumpage was calculated at 255,720 horsepower-days (HP-days). With the addition of the VFD to the large pump, an estimated energy savings of 55,420 HP-days was calculated for an energy savings of 21.7%. Energy efficiency is also realized because the most efficient operating point for the large pump is with no recirculation or throttling. By turning the pump speed down as opposed to throttling, the pump stays at an efficient operating point.

The cost savings, assuming a marginal pumping energy cost of $0.047 per kilowatt-hour, was $23,300 per year, and $306,400 over 20 years, assuming a constant energy cost (conservative). Assuming energy cost increases at a rate of 3% per year, the 20-year present worth would be $407,000. Based on the present worth analysis, the energy savings will not pay for the VFD over a 20-year economic life of the equipment. However, the VFD does save significant energy, allows greater flexibility for operation, and fits in with the long-term sustainability plan for the City of Grand Rapids.

Another present worth consideration is the cost of replacing the 54-inch throttling valve. While the throttling valve has already been replaced outside of the DWRF, continued throttling operation would likely require a new valve every 20 years. The present worth for replacing the 54-inch valve is $175,000, which when added to the escalated energy cost, gives a 20-year present worth of $582,000. The construction portion of the $175,000 is $150,000. Therefore, the energy savings and construction cost 20-year present worth would be $557,000.

The cost of the VFD as presented in the DWRF included $595,000 for construction cost, $36,000 for contingency, and $119,000 for engineering, administration, and inspection. The 20-year present worth for the VFD construction cost ($595,000) is within 10% of the valve construction and energy cost ($557,000).

In summary, the installation of the VFD at the Low Service Pump Station is an Energy Efficiency category project. Installation of the VFD on the large pump results in a 21.7% energy savings, a $23,300 yearly energy cost savings, improved pump efficiency, reduced wear on the 54-inch throttling valve, and an approximate 20-year payback when construction and energy costs are compared.

West High-High Elevated Storage Tank

The West High-High Elevated Storage Tank is being submitted as a GPR project under the Energy Efficiency category. The installation of the West High-High Elevated Storage Tank results in an energy savings of approximately 50%. Looking at just the average day condition, the small pump at the Bristol Booster Pump Station operates at 1.4 mgd and 70 feet of head, but the average demand is only 0.6 mgd. The excess water is recirculated through pressure reducing valves (PRVs) back into the West High Pressure District. Over the course of a year, the demand will fluctuate, but so too will the volume of water recirculated through the PRVs. The two large pumps are designed to provide 4.0 mgd each for fire flow. The large pumps would supply over six times the average day demand, and their use is minimal. Therefore, energy savings was evaluated in terms of the small pump.